

CHAPTER 3. SAFETY

Section 1. GENERAL

3.1.1.1 HAZARDS. Every painting assignment exposes maintenance personnel to conditions and situations that represent actual or potential danger to themselves and to others in the area. The frequent necessity to use toxic and flammable materials, pressurized equipment, ladders, scaffolding, and rigging always presents a potential hazard. Hazards may also be inherent in the very nature of the environment, or caused through ignorance or carelessness of the operator. It is, therefore, extremely important to be aware of all potential hazards, since continuous and automatic precautionary measures will minimize the problem and improve both efficiency and morale of the painting crew.

The following military department publications identify potential hazards and action necessary to safeguard against these hazards:

EM 385-1-1 General Safety Requirements
NAVMAT P-5100 Safety Precautions for Shore Activities
AFM 127-101 Industrial Safety Accident Prevention Handbook.

The above documents are consistent with the standards promulgated by the Secretary of Labor under the Williams-Steiger Occupational Safety and Health Act (OSHA).

3.1.1.1.1 Paint Materials. Most paint materials are hazardous to some degree. All, except water-thinned paints, are flammable; many are toxic and others can irritate the skin. However, most paints are quite safe if simple precautions are followed.

3.1.1.1.2 Surface Preparation Materials. Preparing a surface for painting often requires the use of solvent, acid, or alkali cleaners. All of these will harm the skin unless used with care. Paint removers are also very irritating to the skin. The use of high pressure abrasive or water blasting methods may be hazardous. Pressures as low as 10-15 psi have been known to cause serious injuries. In addition, improper use of equipment or personal protection devices during abrasive blasting operations may result in lung disease. Steam cleaning procedures employ high heat and pressure, both very hazardous to the operator and personnel nearby if not properly handled.

3.1.1.1.3 Equipment. Ladders, scaffolding, and rigging must be used for areas which are not readily accessible from the floor or ground. Pressure equipment is used to prepare surfaces and to apply paint. All of this equipment can be extremely hazardous if handled carelessly. The proper setting up and dismantling of equipment, the required safety checks, and the basic precautions in handling equipment may require more time than their actual use. Nevertheless, precautions should not be omitted on the basis that risk decreases in proportion to time of use.

3.1.1.1.4 Environment. Painting conditions vary from job to job. One obviously hazardous location is the interior of a tank. However, painting the interior of a small room or closet may be more hazardous, since often no special precautions are taken and ventilation may be inadequate. Furthermore,

the painter may encounter other hazards that exist in the area in which he is working in addition to the hazards inherent in the painting operation. For example, slippery floors or obstacles located on the floor may cause falls. Electrical or mechanical equipment may produce shocks or other serious injuries. Uninsulated steam lines or hot pipes may cause severe burns.

3.1.1.5 Painting Crew. Lack of training, experience, or knowledge of hazards on the part of any painter produces a possible threat to the safety of the crew and others in the painting area. An element of risk is present, even when well trained workers follow all prescribed safety procedures. Proper precautions will reduce this risk to a minimum, but no safeguard can guarantee protection against ignorance. Carelessness of even a trained painter will increase hazards tremendously. Deviation from established procedures by taking "short cuts" often produces unsafe working conditions resulting in accidents with consequent loss of time and materials and of greatest concern, human suffering.

3.1.1.6 Degree of Hazard. The risks involved vary from job to job. Painting the interior of a home with water-thinned paints, for example, is much less of a hazard than painting a water tank 100 feet above the ground. The foreman is responsible for taking the special precautions, designating the equipment required, and advising his crew of the specific hazards of each job. However, the painter should never forget that hazards exist in every job, though they vary in degree. To ignore these hazards is to increase the odds that accidents will occur. Relaxing of precautions in one job will inevitably lead to carelessness in all jobs, regardless of the degree of hazard. Thus habits are formed which will eventually result in an unnecessary increase in the accident rate.

3.1.2 SAFETY MEASURES. The potential hazards present in all painting operations make a continuing and enforced safety program absolutely essential. Adequate safety procedures will provide protection against the three major types of hazards, namely, accidents, fire, and health. All personnel must be thoroughly familiar with safety rules. Each worker is responsible for adhering to all established precautionary programs for his own protection as well as that of others. Disregarding safety measures will increase potential dangers and the odds that an accident will occur. See Corps of Engineers Manual EM 385-1-1, General Safety Requirements, Department of the Navy Manual, NAVMAT P-5100; Safety Precautions for Shore Activities; Air Force Manual AFM 127-101, Industrial Safety Accident Prevention Handbook; and MIL-STD-1212, Industrial Safety Belts and Straps.

3.1.2.1 General Health. All personnel required to perform painting operations should be given physical examinations to determine their ability to perform assigned tasks. Painters who have a history of sensitization or reactions to specific paints should not be assigned tasks which would expose them to these substances.

3.1.2.2 Environment. Study the working environment before sending painters into any work area. Look for hazards such as poor ventilation and noxious fumes. Before a painter is allowed to enter such an area, he must be protected by devices that will allow him to work in safety. Ventilation requirements and respiratory equipment shall be determined by competent safety/health officials. If exhaust systems are used, such as in a tank, for example, the system must take suction from the area in which the work is being

done. Never work alone in a hazardous area (see 3.1.2.6). The discharge from exhaust systems must be arranged so that contaminated air will not be returned to the work area or create a health hazard in surrounding areas. Temperatures should be kept at 65° F to 75° F, if possible.

3.1.2.3 Respiratory Protection. Personnel must wear the proper type of respirator in hazardous areas. All devices must be approved by the National Institute for Occupational Safety and Health (NIOSH). The most important types of respirators are as follows:

a. Dust respirators for protection against toxic and nontoxic particulates. These respirators filter out the air contaminants. (See Figure 3-1.)

b. Chemical cartridge respirators for protection against gases and solvent vapors. These respirators contain activated carbon cartridges which absorb the fumes or vapors. (See Figure 3-2.)

c. Supplied air respirators (see Figure 3-3) for use in closed areas where ventilation cannot be supplied (oxygen deficient) where the atmosphere concentration of a material exceeds the concentration limitations listed on a chemical cartridge respirator, or where the contaminant concentration or oxygen content of an atmosphere is unknown. Fresh air blowers, respirator, and ancillary equipment of the positive pressure type shall be Mine Safety and Health Administration (MSHA)/NIOSH approved. Each respirator shall be supplied by one blower unless each hose line is connected to a manifold at the blower. Hoses must be limited to 300 feet.

d. Abrasive blasting helmets for use when blast cleaning surfaces to be painted. (See Figure 3-4.)

See Department of the Army Technical Bulletin TB MED 223, Department of the Air Force Pamphlet AFP 161-1-1, Respiratory Protective Devices; Department of the Navy NAVFAC guide specification TS-13657, Cleaning Petroleum Storage Tanks, and Department of Defense MIL-ST-457, Frequency for Inspection and Cleaning of Petroleum Fuel Operating and Storage Tanks. The life or health of the wearer may depend on the availability and proper functioning of respiratory equipment. They must be cleaned immediately after use and be properly maintained and stored in clean, dry compartments. Filters, cartridges, and rubber parts should be inspected before each use and at regular intervals for any signs of deterioration. Replace any suspect filter or cartridge immediately.

3.1.2.4 Eye Protection. Safety goggles must be worn where there is any possibility of dust, fumes or solvents touching the eyes as may occur when blasting, sanding, or spraying. They must be kept clean and readily available. They should fit well, contain lenses of unbreakable glass or plastic, and allow adequate peripheral as well as straight ahead vision. (See Figures 3-5 and 3-6.)

3.1.2.5 Protective Clothing. Personnel should wear clean clothing covering them as much as possible, e.g., coveralls, to avoid skin contact with painting or cleaning materials. Cuffs, tears or rips, loose pockets, loose



FIGURE 3-1
Mechanical Filter Respirator



FIGURE 3-2
Chemical Cartridge Respirator



FIGURE 3-3
Supplied Air Respirator

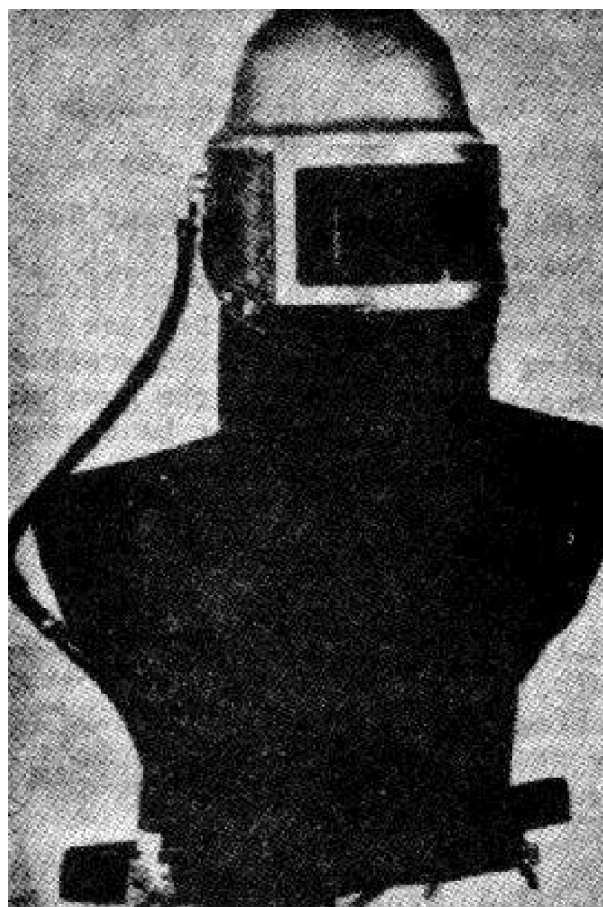


FIGURE 3-4
Abrasive Blasting Helmet

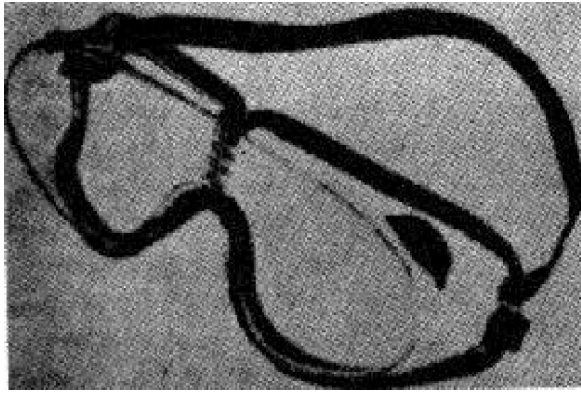


FIGURE 3-5
Safety Goggles

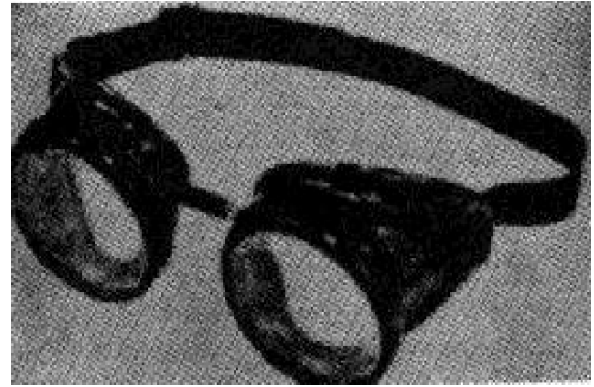


FIGURE 3-6
Safety Goggles

ties, and jewelry should be avoided since they are potential causes of accidents. Safety helmets should be worn when using abrasive blasting media. (See Figure 3-4). Hard hats and steel toed safety shoes should be worn whenever there is any possibility of danger from falling objects. Shoes should have nonskid rubber soles when working in enclosed spaces or where flammable vapors must be present. Acid-proof clothing should be worn when handling acid cleaners. Use acid-proof air-supplied suits when using acid cleaning materials in enclosed areas. (See Figures 3-7 thru 3-10.)

3.1.2.6 Buddy System. Personnel should never work alone in hazardous areas. At least two men shall be assigned to such jobs, and each should be visible to the other at all times during painting operations. Then, if one should have an accident, the other can immediately come to his aid.

3.1.3 RESPONSIBILITY OF FOREMEN. The foreman should lay out the work and manage projects in such a manner so as to create the safest possible conditions. Safety of personnel is one of his prime responsibilities. A hazard analysis should be made and safety check-off list, as illustrated in Figure 3-11, should be used by the foreman before a job gets underway. In addition, all foremen should adhere to the following program:

- a. Always be aware of potential hazards in the area.
- b. Be sure that each painter understands and accepts his personal responsibility for safety and that he is informed of all safety rules.
- c. Be sure that all safety measures have been taken each day before any job is started.
- d. Insist that the men work safely. Use disciplinary action in accordance with existing personnel directives, if necessary.
- e. Be sure that all equipment meets safety standards. Use nonsparking tools in hazardous areas. Anticipate possible risks with new types of equipment. Secure expert advice on potential hazards in advance.
- f. Encourage the men to discuss the hazards in their work. No job should proceed if any question about safety remains unanswered. Be receptive to their ideas and suggestions; these may be the best source of field experience that will prevent accidents.

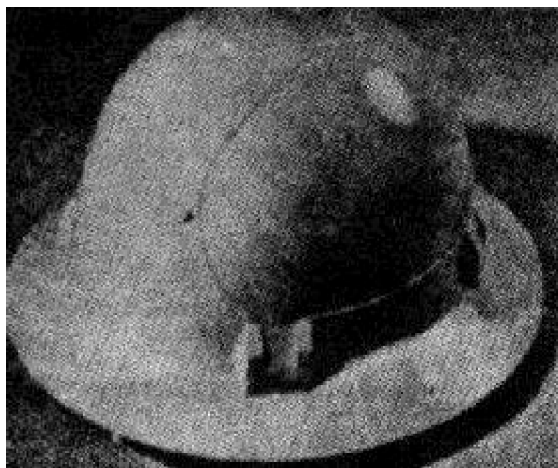


FIGURE 3-7
Hard Hat



FIGURE 3-8
Safety Shoes



FIGURE 3-9
Acid Proof Clothing



FIGURE 3-10
Acid-Proof Air-Supplied Suit

- ☐ "No Smoking" warnings
- ☐ Clothing
- ☐ Eye protection
- ☐ Respiratory protection
- ☐ Safety belts and lines
- ☐ Warning tags and signs
- ☐ Hazardous materials
- ☐ First aid
- ☐ Falling objects
- ☐ Electrical hazards
- ☐ Working surface
- ☐ Moving objects, cranes, traffic, etc.
- ☐ Safety showers and eye baths
- ☐ Fire alarm station
- ☐ Fire extinguishers, fire blankets
- ☐ Nearest telephone
- ☐ Barricades
- ☐ Equipment grounded
- ☐ Sparkproof tools
- ☐ Safety or fire permits
- ☐ Flammability or flash point
- ☐ Condition of ladders and scaffolding
- ☐ Buddy system

FIGURE 3-11
Safety Check List

Section 2. ACCIDENT HAZARDS

3.2.1. CAUSES. Accidents during painting operations are caused by unsafe work equipment, hazardous working conditions, and careless personnel. Any of several of the following can cause accidents:

- a. Lack of knowledge, experience, and training in the use of painting materials and equipment.
- b. Defective tools, protective apparel, and equipment.
- c. Failure to use protective apparel, the right tools or equipment or protective creams.
- d. Improper use of equipment, tools and protective apparel.
- e. Failure to consider environmental conditions and existing hazards in work areas before, during, and after painting operations.

Accidents most frequently involve commonly used equipment. The most common and serious accidents, by far, are falls either from a height or on the ground because of a loss of footing. Falling or moving objects are the next most serious hazard.

3.2.2 PRECAUTIONS AND PREVENTION. Nothing should be taken for granted. Proper use of equipment must be taught by qualified personnel. Refresher courses on the use of all equipment must be regularly scheduled.

3.2.2.1 Equipment Check and Use. The following basic procedures in setting up and use of equipment are imperative to assure safety standards and maximum protection of all personnel.

a. Ladders:

- (1) Store wood ladders in a warm dry area protected from the weather and ground.
- (2) Protect wood ladders with clear coatings only, so that cracks, splinters, or other defects will be readily visible.
- (3) Inspect ladders in use at least daily for loose or bent parts, cracks, breaks, or splinters. Defects shall be repaired or ladders condemned depending upon the degree of deficiency.
- (4) All straight and extension ladders must have safety shoes. (See Figure 3-12.)
- (5) Do not use portable ladders greater in length than can be readily carried and placed by two men. Never splice ladders to form a longer ladder.

(6) Extension ladders should have a minimum overlap of 3 feet for ladders up to and including 36 feet, 4 feet for ladders over 36 feet up to and including 48 feet, and 5 feet for ladders over 48 feet up to and including 60 feet. (See Figure 3-13.)

(7) Do not use stepladders over 12 feet high. Never use one as a straight ladder. Never stand on the top step. A second man should always hold the step ladder when a worker is standing on the ladder 8 feet or more above the floor.

(8) Place ladders so that the horizontal distance from the top support to foot is at least one-fourth of the working length. Be sure that the ladder is securely in place. Rope off all doorways in front of the ladder and place warning signs.

(9) Use hand lines to raise or lower tools and materials. Do not overreach when working on ladders. Move the ladder instead.

(10) Never use metal ladders in areas where contact with electric power lines is possible.

(11) Employees shall face the ladder and use both hands when ascending or descending.

(12) Stepladders shall be fully opened during use. A metal spreader or locking device shall be a component for each stepladder.

(13) Straight ladders shall be secured.

(14) Rungs shall be kept free of grease and oil.

(15) Portable ladders shall be so placed that the side rails are on a stable footing. The top rest for portable rung and cleat ladders shall be reasonably rigid with ample strength to support the applied load.

(16) Ladders shall be protected by barricades when used at work locations in hallways, doorways and stairways. A ladder should never be placed in front of a doorway unless the door is locked, blocked, or guarded.

(17) Ladders shall never be used as horizontal scaffold members.

(18) Ladders shall not be used by more than one worker at a time.

(19) No ladder shall be used to gain access to a working level unless the top extends at least 3 feet above the point of support.

b. Scaffolding (See Figures 3-14 through 3-21 for types of scaffolding):

(1) Inspect all parts before use. Reject metal parts damaged by corrosion/deformation and wood parts with defects such as checks, splits, unsound knots, and decay which may reduce its strength. Scaffolding and its use shall conform to ANSI A 10.8 (Feb 1974).

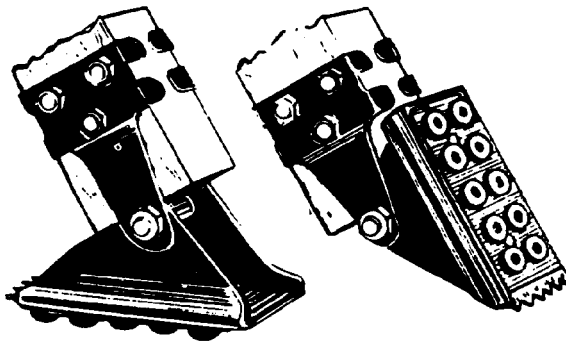


FIGURE 3-12
Ladder Safety Shoes

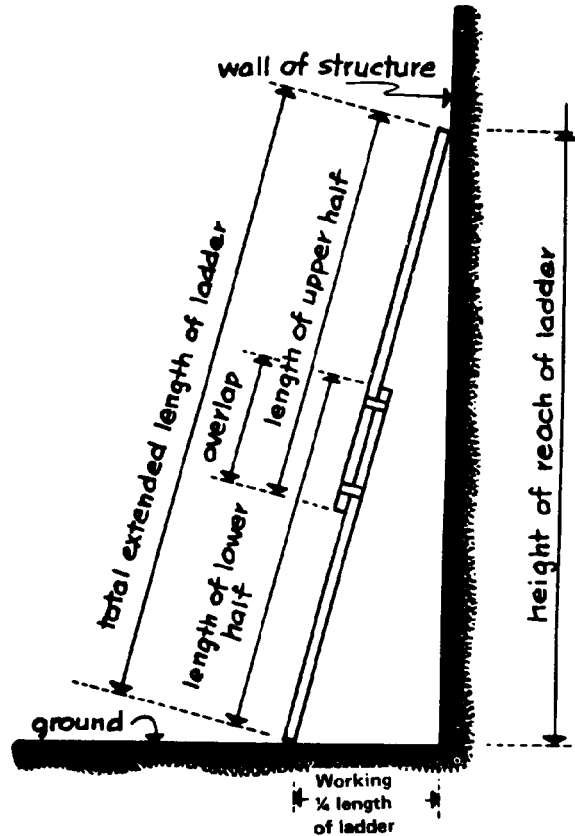


FIGURE 3-13
Ladder Stability

(2) The supporting members shall be placed on firm, rigid, smooth sills, or underpinings. The poles, legs, or uprights of scaffolds shall be plumb and braced securely and rigidly to prevent swaying and displacement.

(3) Anchor scaffolds to the building or structure or, if independent of the structure, brace or guy the scaffolds at intervals not to exceed 25 feet horizontally and 15 feet vertically. Do not force braces to fit. Use horizontal diagonal bracing at bottom and at every 25 feet of elevation.

(4) Lumber should be straight grained. All nails should be driven full length and not subject to direct pull.

(5) Provide guard railings regardless of height on the full length of the scaffold and also on the ends.'

(6) Erect scaffolding so that an access ladder or equivalent safe access shall be provided to all work areas. Built-in ladders shall conform to ANSI A14.3, Safety Coded for Fixed Ladders. Climbing of braces is prohibited.

(7) Tubular pole scaffolds should be made of 2-inch O.D. galvanized steel tubing or other corrosion resistant metal of equal strength. They should be erected or dismantled by 'experienced personnel only.

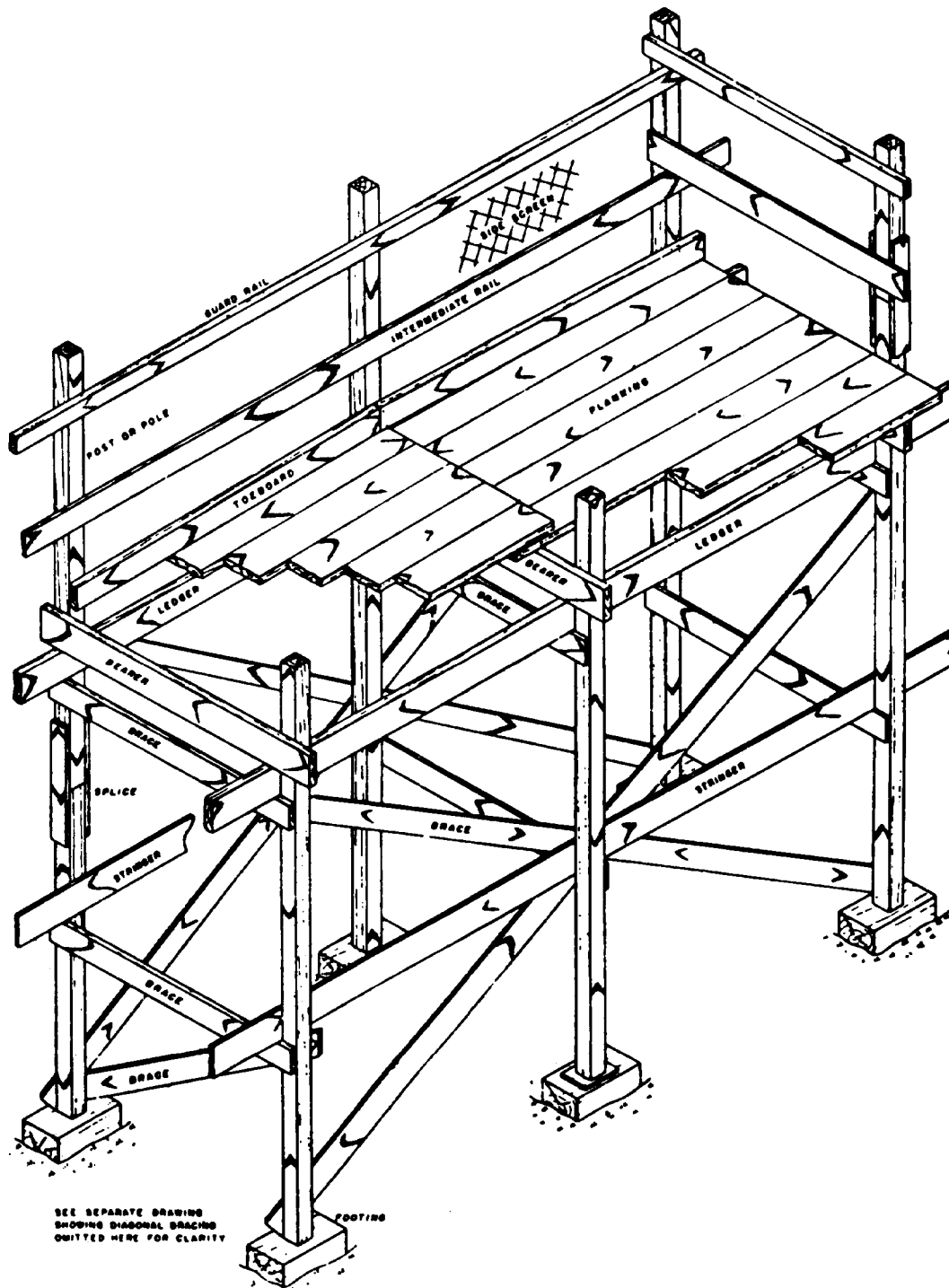


FIGURE 3-14
Double Pole or Independent Scaffolding

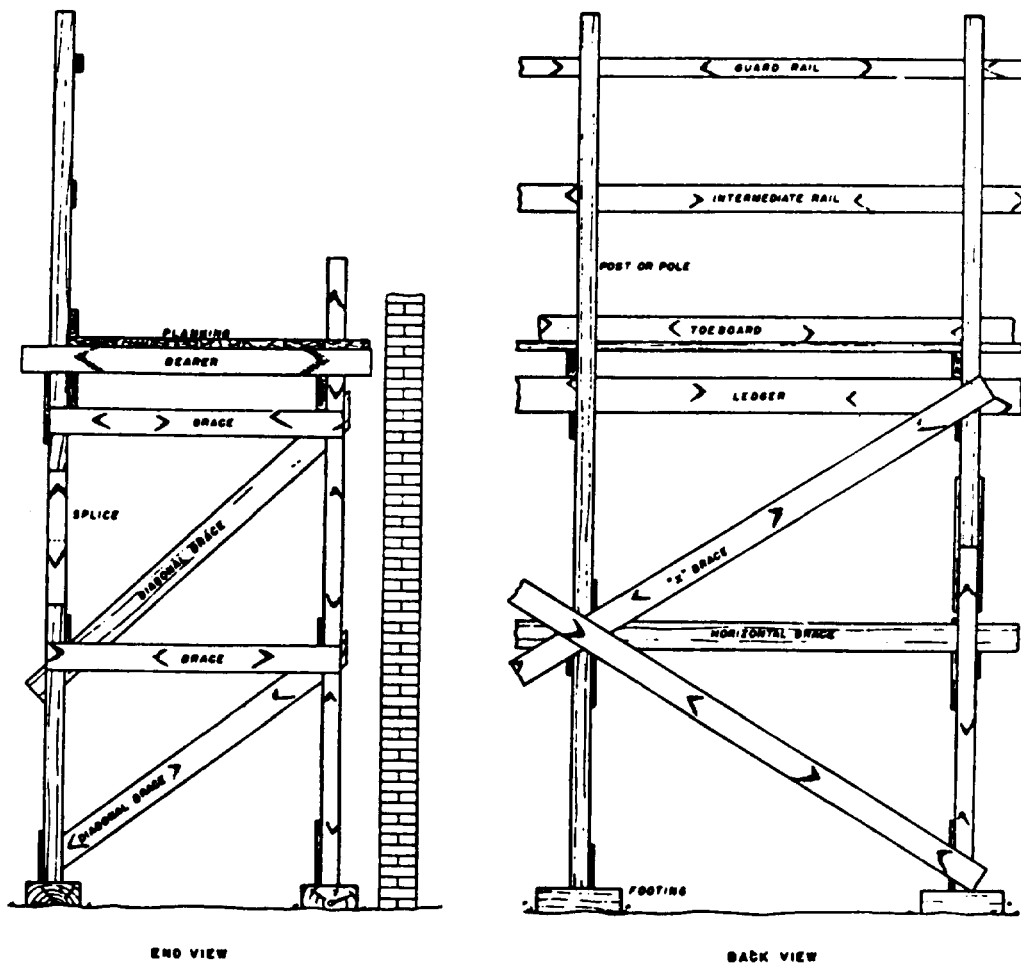


FIGURE 3-15
Diagonal Bracing on Double Pole Scaffolding

(8) Planking should have at least a 2-foot overlap. Secure well to wood scaffolding. Platforms shall be made of planking of uniform thickness laid close together. They must overlap and be fastened at supports. Do not use planking for other purposes; paint them only at the ends to identify them. Nominal sizes of planking shall be determined from Table 3-1. Values are given in pounds for loads at center and allow for weight of planking.

(9) Test scaffolds and extensible planking (extended to working length) by raising them 1 foot off the ground and loading them with weights at least 4 times the anticipated working load.

(10) Scaffolds, platforms, or temporary floors shall be provided for all work except that which can be done safely from the ground or other substantial footing.

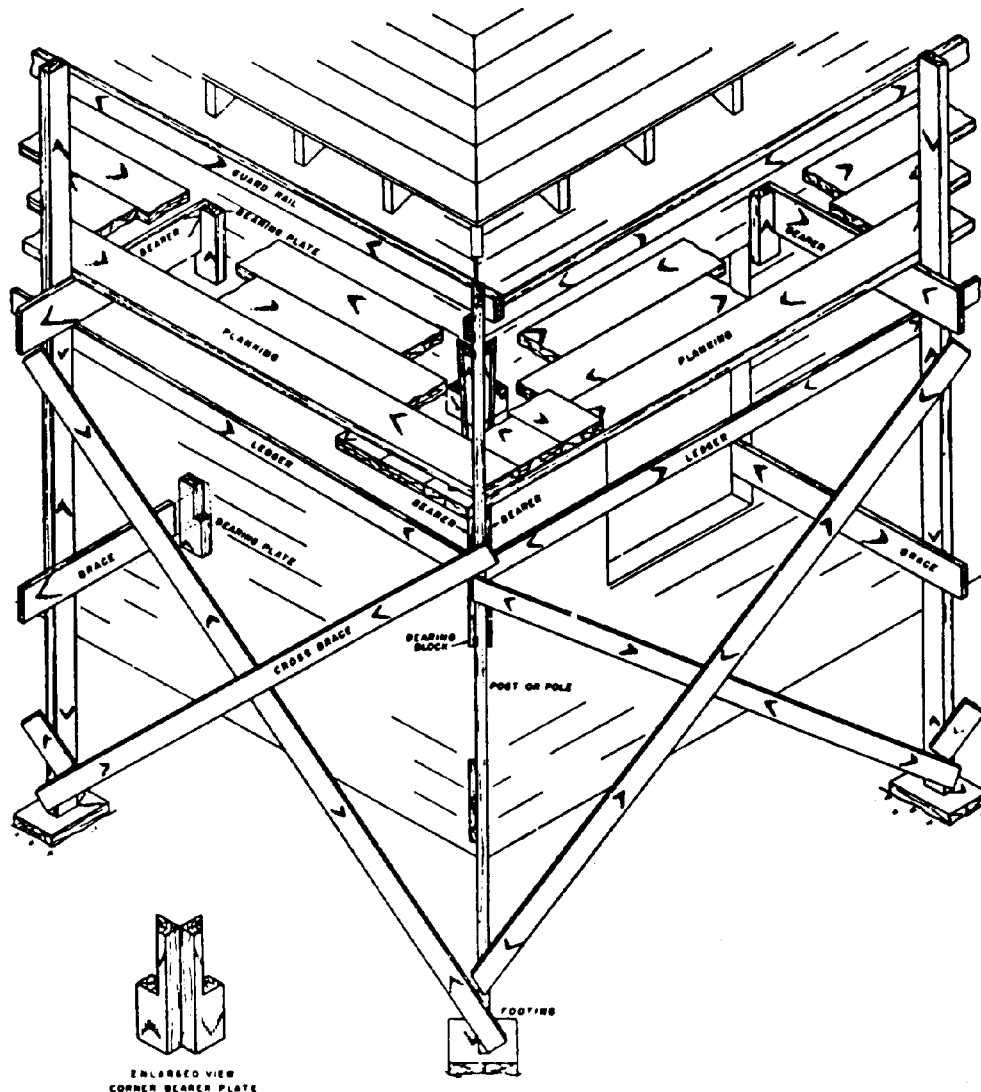


FIGURE 3-16
Single Pole Scaffolding-Corner Construction

(11) Scaffolds and other working surface shall be kept free of ice, snow, grease, mud, or any material or equipment which will render them unsafe or hazardous to persons using them. Abrasive material shall be used, when necessary, to ensure safe footing.

(12) All scaffold shall be at least 18 inches wide and be effectively guarded by guardrails, intermediate rails, and toe boards extending the full length and on the ends of the scaffold. Guard rails shall be 42 inches high.

(13) Lumber used in the construction of scaffolds and accessways shall be of good quality, reasonably straight-grained, free of shakes, checks, splits, cross grains, unsound knots or knots in groups, decay and growth characteristics, or other condition which will materially decrease the strength of the material.

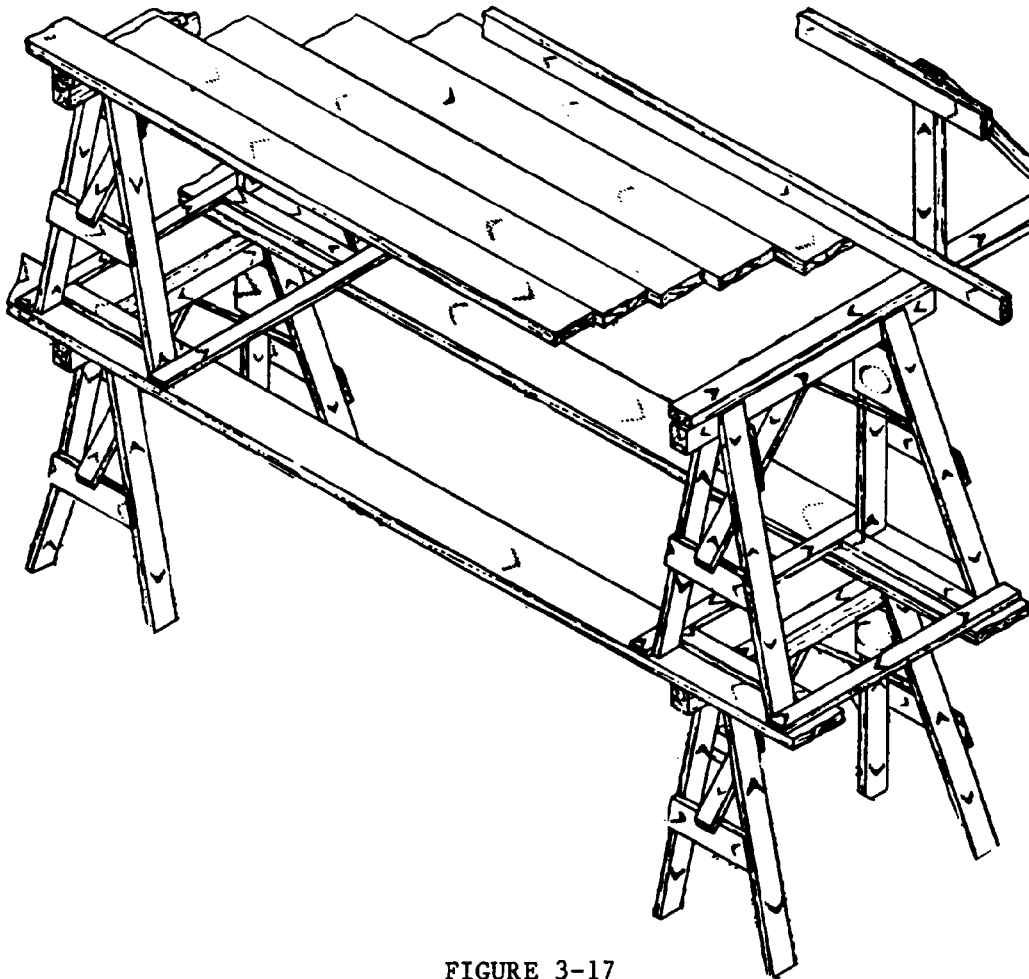


FIGURE 3-17
Horse Scaffold, Two Tiers (Maximum Height 2 Tiers or 10 Feet)

TABLE 3-1
Safe Center Loads for Scaffold Plank

Span Feet	2 x 8*	2 x 10*	2 x 12*	3 x 8*	3 x 10*	3 x 12*
6	200	255	310	525	665	805
8	150	190	230	390	500	605
10	120	155	185	315	400	485
12	100	130	155	265	335	405
14	--	110	135	225	285	346
16	--	--	115	195	250	305

Above values are for planks supported at the ends, wide side of plank face up, and with loads concentrated at the center of the span. For loads uniformly distributed on the wide surface throughout the length, the safe loads may be twice those given in the table. Loads given are net and do not include the weight of the plank. If select structural coast region Douglas fir, merchantable structural longleaf southern pine, or dense structural square edge sound southern pine are used, above loads may be increased 25 percent.

*Dressed sizes of planks, reading left to right, are: 1 5/8 x 7 1/2, 1 5/8 x 9 1/2, 1 5/8 x 11 1/2, 2 5/8 x 7 1/2, 2 5/8 x 9 1/2, 2 5/8 x 11 1/2, respectively.

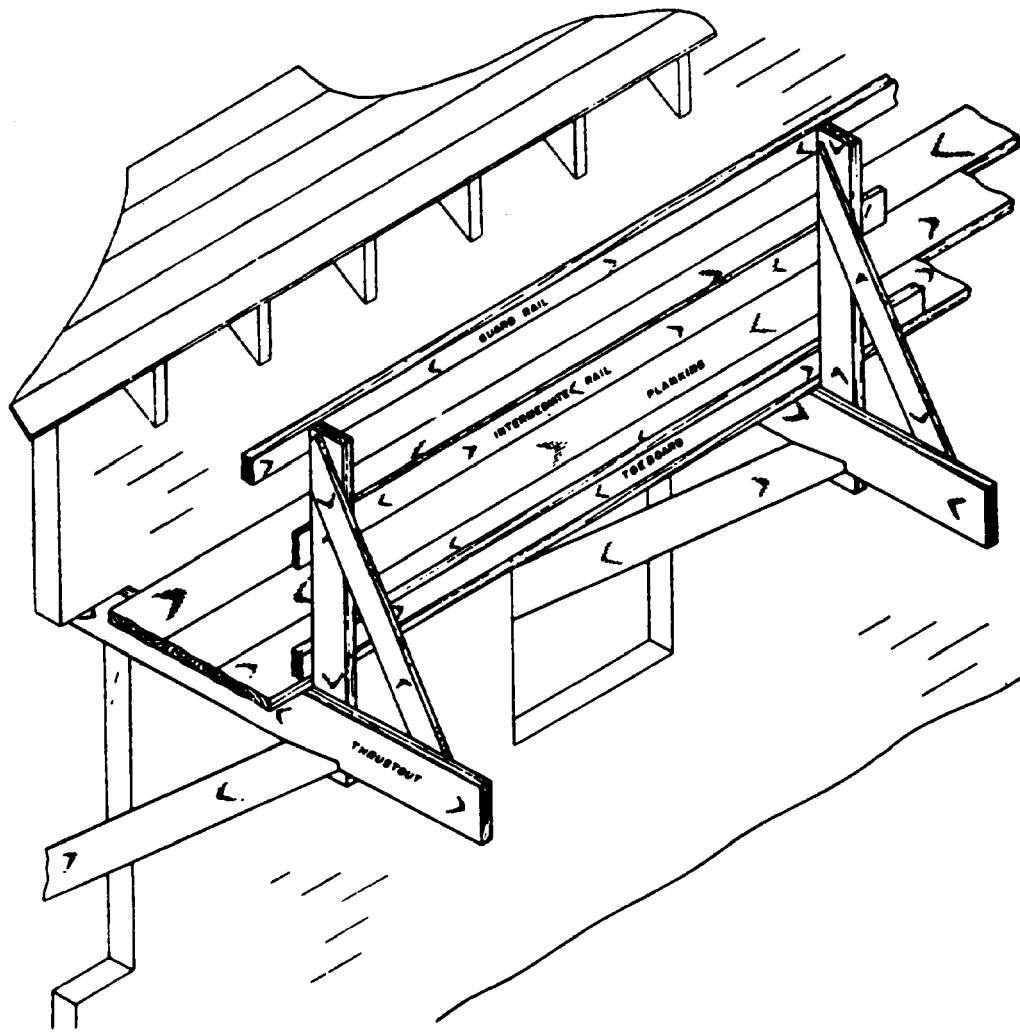


FIGURE 3-18
Outrigger Scaffold With Guard Rail

(14) Planking shall be supported or braced to prevent excessive spring or deflection and secured to prevent loosening, tipping, or displacement.

(15) Lean-to and prop-scaffolds are prohibited.

(16) Climbing on braces is prohibited.

(17) Operations adjacent to overhead power lines shall be prohibited unless the power line is de-energized or equipment and personnel are prevented by positive means from approaching closer than 10 feet to the power line. See General Safety Requirements Manual, EM 385-1-1, for minimum clearances for the various power line ratings.

(18) Flexible materials such as wire and fiber ropes shall not be used as guard rails.

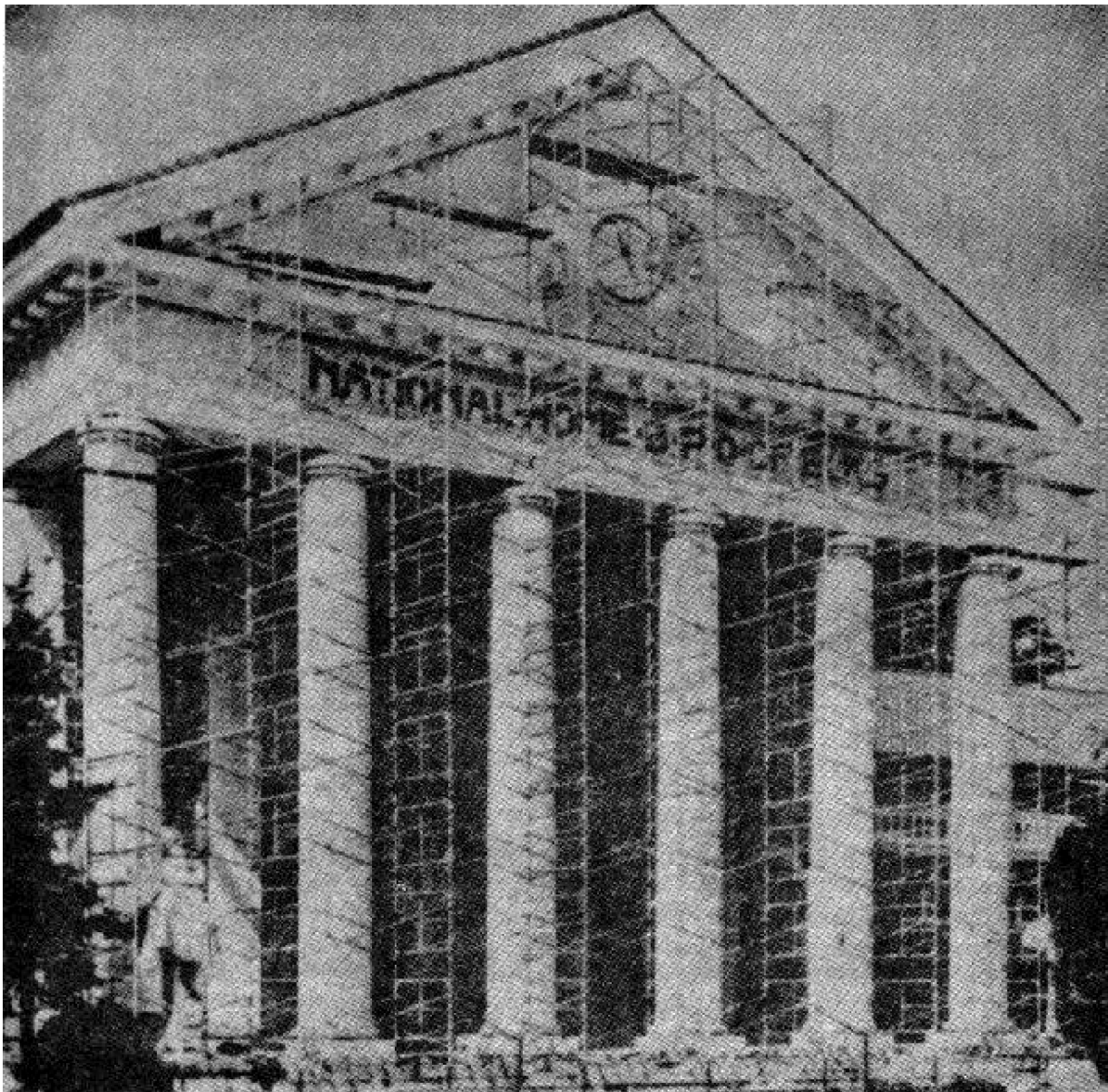


FIGURE 3-19
Pipe Scaffolding

c. Rolling Towers:

(1) Inspect all tower parts before use. Do not use parts which are damaged by corrosion, deterioration, or misuse.

(2) Secure towers with heights more than 3 times the minimum base dimension at least every 15 feet of elevation. Use horizontal diagonal bracing at bottom and at every height of section.

(3) Provide unit lock arms on all towers. Do not use casters less than 6 inches in diameter. Do not extend adjusting screws more than 12 inches.

(4) Do not ride towers. Look where you are going when moving them.

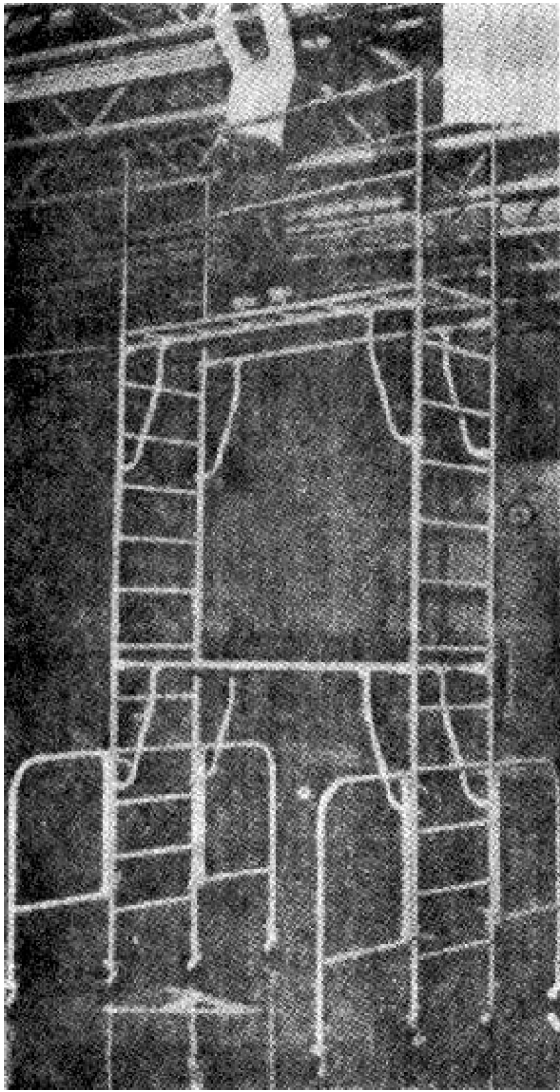


FIGURE 3-20
Pipe Scaffolding
Roller Outrigger Type

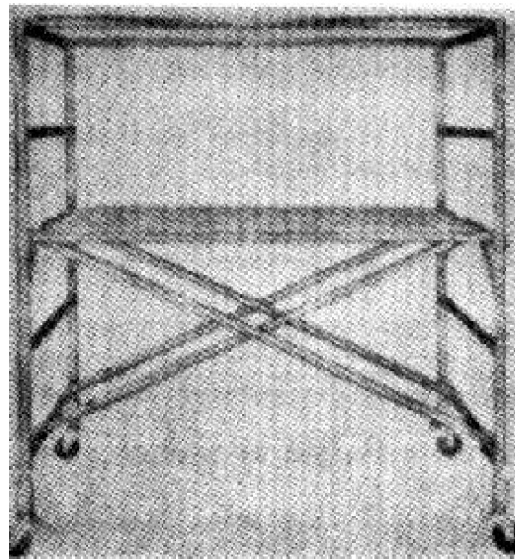


FIGURE 3-21
Pipe Scaffolding
One-Man Assembly Type

Do not attempt to move a tower without sufficient help. Apply all caster brakes when tower is stationary.

d. Swinging Scaffolds, Swing Stages, Bosun Chairs (See Figures 3-22 through 3-24):

(1) Always read instructions on the proper use and maintenance of the equipment. Follow prescribed load capacities.

(2) Stages should be at least 27 inches wide and supplied with guard rails (not rope).

(3) Only experienced personnel are permitted to erect or operate stages. Check ropes and blocks before use by suspending stages 1 foot off the ground and loading at least 4 times the anticipated work load. Before locating on the job site, check for nearby electric power lines.

(4) Power stages should have free fall safety devices with hand controls in case of power failure.

(5) Scaffold machines, either powered or hand powered, shall be worm geared or powered both ways. Design must be such that the scaffold cannot move when the power is stopped.

(6) In addition to the normal operating brake, all power-driven units shall have an emergency brake which engages automatically when the normal speed of descent is exceeded.

(7) Suspended scaffolds shall be guyed, braced, or equipped with tag lines to prevent swaying.

(8) Brackets shall be wrought iron or mild steel. No reinforcing steel shall be used as any part of a support system. Brackets shall have attachments for guard rails, intermediate rails, and toeboards.

(9) Suspended scaffolds shall have a guard rail, an intermediate rail, and toe-board.

(10) Inspect all parts before use. Each worker on a suspended scaffold shall be protected by a safety belt attached to a lifeline by a lanyard and fall preventive device. No more than two men shall be permitted to work at one time on suspension scaffolds designed for a working load of 500 pounds and no more than three on a suspension scaffold designed for a working load of 750 pounds. The working load includes men and equipment.

e. Ropes and Cables:

(1) Fiber rope shall be stored in a dry place where air circulates freely about it and where it is safe from deleterious fumes, heat, chemicals, moisture, rodents, and biological attack.

(2) Use wire rope at least three-fourths of an inch in diameter for all suspended platforms except bosun chairs and life lines, for which rope of at least five-eighths-inch diameter is required. Use proper clamps with wire rope, and proper knots and hitches when handling materials with manila rope. (See Figure 3-25.)

(3) Inspect ropes frequently. Discard if exposed to acid or excessive heat. Check for dry rot, brittleness, or excessive wear. Never use frozen rope.

(4) Inspect all wire ropes and cables frequently in accordance with current service safety criteria.

(5) Do not attempt to salvage rope and cable by splicing.

f. Pressurized Equipment. (These rules apply to all types of equipment used both for spraying and blasting):

(1) Use only approved equipment. Use remote control deadman valves on high pressure equipment (60 psi or higher). These should be activated by the same air used for blasting or spraying. See Air Force Technical Orders T.O. 00-25-232N, High and Low Pressure Terminology and T.O. 34Y1-1-171, Hydrostatic Testing.

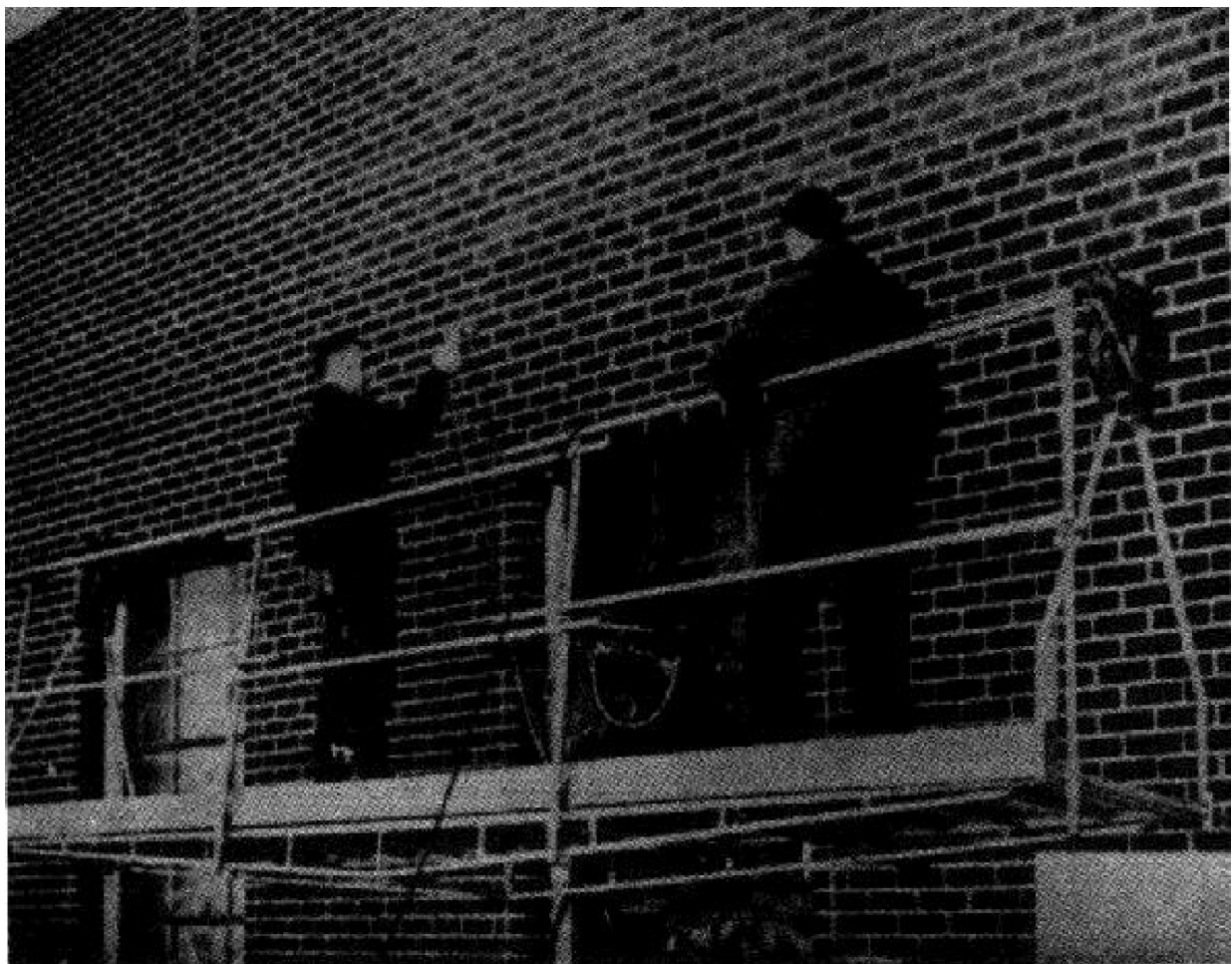


FIGURE 3-22
Swinging Scaffold--Ladder Platform Type

(2) Conduct a hydrostatic test at least once, preferably twice a year. Test safety relief valves daily.

(3) Use conductive hose. Ground nozzles, tanks, and pressure equipment when in use, also object to being sprayed. (See Figures 3-26 and 3-27.)

(4) Store hose in dry areas. when in use, avoid sharp bends, especially when curved around an object. Secure high pressure hose no more than 10 feet from operator.

(5) Never point the gun or nozzle at anyone or any part of the body. When handling or carrying, hold by the grip and remove fingers from the trigger.

(6) Release all pressure before disconnecting any part of the equipment.

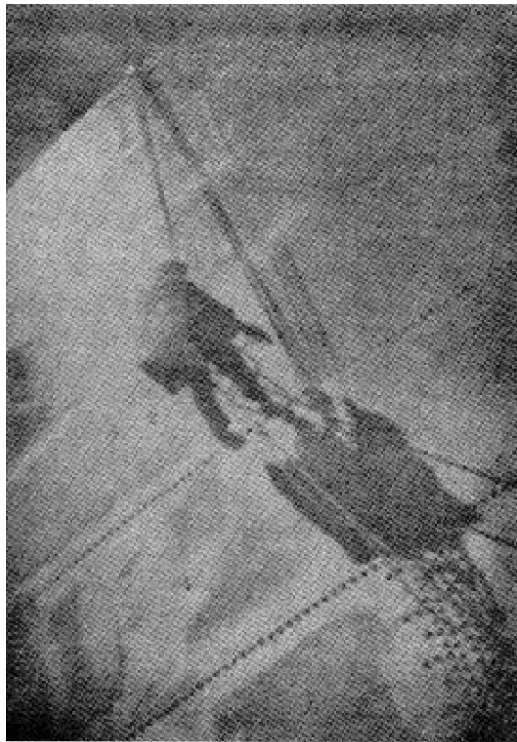


FIGURE 3-23
Bosun Chair

Section 3. FIRE HAZARDS

3.3.1 CAUSES. Most paint products are highly flammable and extremely dangerous when they or their vapors are exposed to open flames, sparks, or excessive temperatures. Flammable liquids and vapors, especially the latter are by far, the chief causes of fire and explosion.

3.3.1.1 Solvents. Most paint products are flammable because of the solvents they contain. These solvents are highly volatile; some flash, in the presence of a flame, at temperatures below normal ambient painting temperatures. Thus, they may be safe in cold weather yet be potentially dangerous in midsummer. It is safer to use paint materials which will flash at temperatures significantly higher than painting temperatures, since environmental changes can quickly change a safe condition to a dangerous one. For example, mineral spirits, with a flash point of 105° F, is considerably safer to use than V M & P naphtha (benzine) which has a flash point of 50° F or less. Furthermore, a paint, varnish, or lacquer containing a mixture of solvents will flash at a temperature close to that of the most volatile solvent since this solvent vaporizes more quickly than others. A low flashing paint material cannot be made safe by blending with another having a higher flash point. Since low flashing solvents volatilize or vaporize readily, they are most likely to bring about high concentrations of vapor in enclosed spaces. This is especially true when spraying, since spray paints usually contain low flashing solvents to accelerate drying. A spray gun which applies a pint to a quart of paint per minute will cause a much greater concentration of vapor than a dozen brush painters. Every gallon of solvent in the paint will create more than 100 gallons of potentially dangerous gas or vapor. This condition is even more dangerous in confined spaces since it is possible to cause an explosion, if a

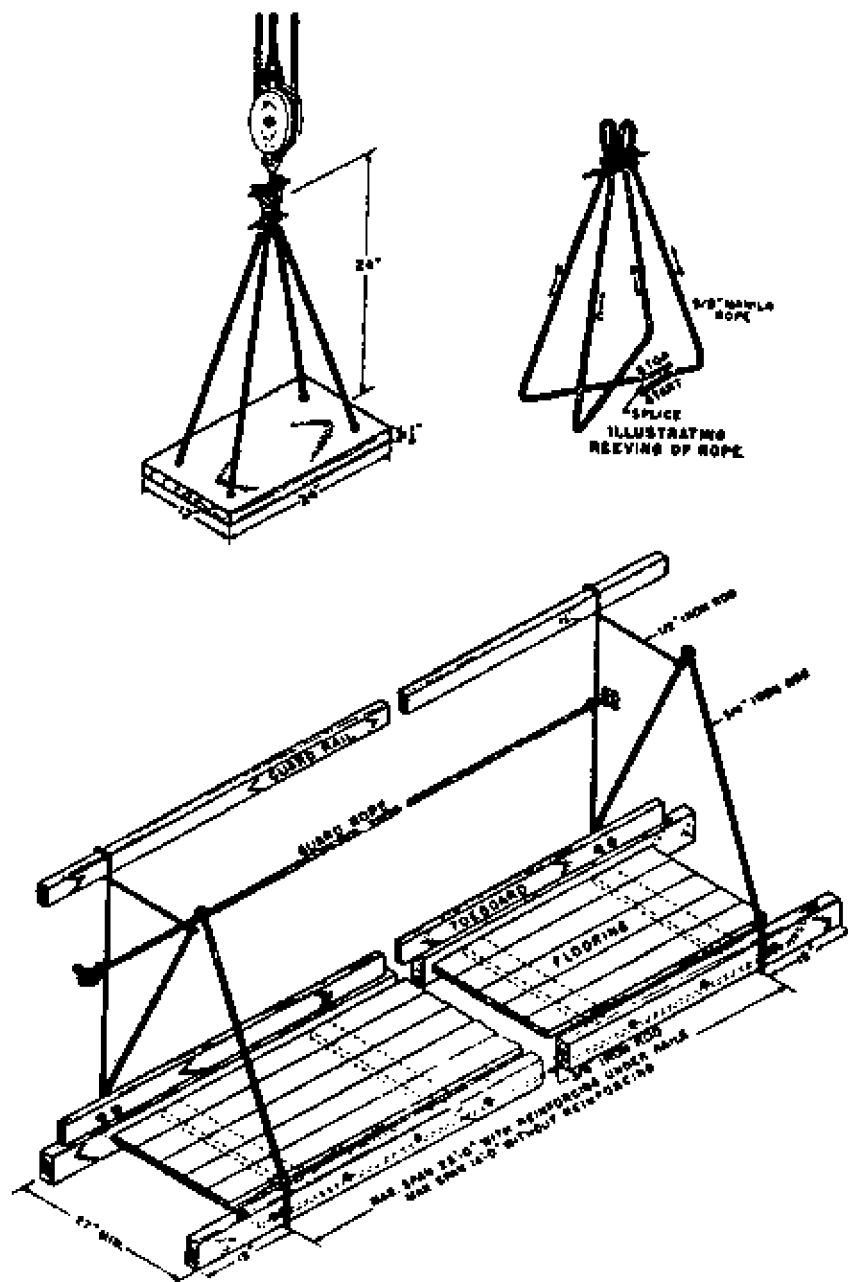


FIGURE 3-24
Bosun Chair and Swinging Scaffold
(Construction Details)



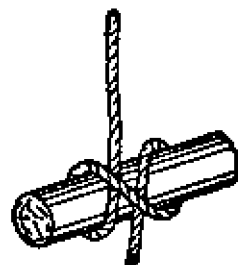
SQUARE KNOT



SHEET BEND



BOWLINE



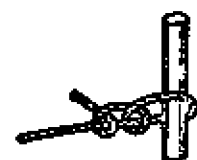
GLOVE HITCH



ROLLING HITCH



RUNNING BOWLINE



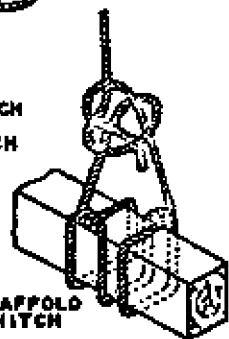
TWO HALF HITCHES



ROUND TURN AND TWO HALF HITCHES



TIMBER HITCH AND HALF HITCH



SCAFFOLD HITCH

FIGURE 3-25
Knots and Hitches Used in Painting Operations

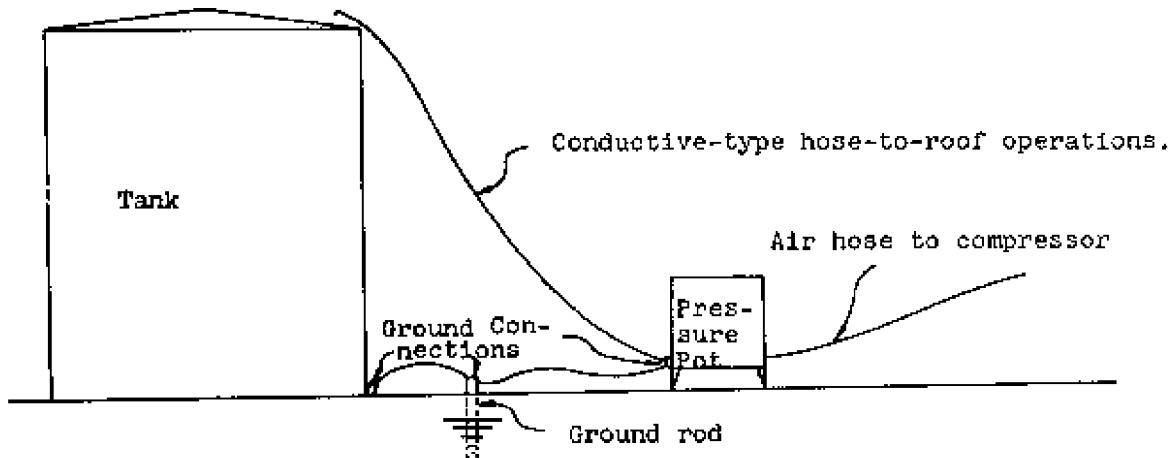


FIGURE 3-26
Grounding of Tank Equipment

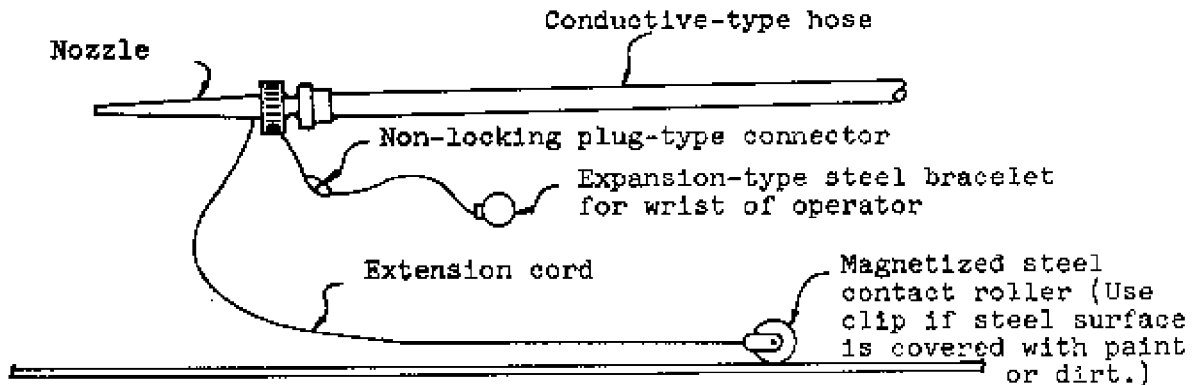


FIGURE 3-27
Grounding of Blast Nozzle

critical ratio of solvent vapor-to-air is reached, in the presence of a flame or spark. This is why spray equipment must be grounded to prevent ignition by a spark from static electricity. Furthermore, solvent vapors, which are heavier than air, will move along the ground for dozens of yards from the area of application. For this reason, all flames must be extinguished anywhere near the painting area. Flash points and flammable vapor/air limits of common paint solvents are given in Appendix C.

3.3.1.2 Oil Paints. Many exterior paints for wood and steel are based on raw or refined linseed oil. These represent a very definite fire hazard if paint-soaked waste or wiping rags are allowed to remain lying around. As the paint dries, the oxidation of the oil can cause the temperature to rise to the point where the rag or waste material will ignite spontaneously. The situation is especially dangerous with rags contaminated with pure raw or boiled linseed oil. (See Figure 3-28.)

3.3.1.3 Other Paints. The majority of paints applied on site contain high flash solvents (over 100° F); therefore, they are relatively low in hazard and

require only normal precautions. However, some finishes represent an abnormal fire and explosion hazard. Among these are spray finishes as described in 3.3.1.1 because of the low flashing solvents used. Others are nitrocellulose lacquers which burn rapidly because of the nitrocellulose present, and two-component products which are subject to spontaneous combustion if mixed in large quantities.

3.3.2 PRECAUTIONS AND PREVENTION. Certain general rules regarding fire and explosion hazards apply to all situations. All paint materials should have complete label instructions which stipulate the potential fire hazards and precautions to be taken. Painters must be continuously advised and reminded of the fire hazards that exist under the particular conditions of each job, so that they will be aware of the dangers involved and ensure that the necessary precautions are taken and maintained. Fire fighting equipment of the proper types must always be readily available in the paint shop, spray room, and work areas where a potential fire hazard exists. Electric wiring and equipment installed or used in the paint shop, including storage room and spray room, must conform to the applicable requirements of the National Electrical Code for Hazardous Areas.

3.3.2.1 Specific Safety Measures.

- a. Prohibit smoking anywhere that paint is either stored, prepared for use, or applied.
- b. Provide for adequate ventilation in all of these areas.
- c. Perform recurrent spray operations on portable items, e.g., signs in an approved spray booth equipped with adequate ventilation, a water wash system of fume removal, and explosion proof electrical equipment.
- d. Wet down spray booth surfaces before cleaning them.
- e. Portable metal ladders shall not be used in hazardous atmospheres within 10 feet of exposed electric wiring. Personnel should wear rubber soled shoes.
- f. Use nonsparking scrapers and brushes to clean metal surfaces where fire hazards are present.
- g. Wet down paint sweepings, rags, and waste with water, and store in closed metal containers until disposed of in an approved manner. Do not burn in heaters or furnaces. (See Figure 3-29.)
- h. Extinguish all pilot lights on water heaters, furnaces, and other open flame equipment on all floors of the structure being painted. Be sure to turn the gas valve off.
- i. When painting in confined areas near machinery or electrical equipment, open all switches and tag them to prevent their being turned on inadvertently.
- j. Be sure that all mixers, pumps, motors, and lights used in the paint shop, spray room or on the job are explosion proof and electrically grounded.



FIGURE 3-28
Combustible Waste, Separate Containers

k. Use pails of sand (never sawdust) near dispensing pumps and spigots to absorb any spillage or overflow.

l. During painting operations keep fire extinguishers nearby. Be sure that they are of the proper type. (See Table 3-2.)

m. Check ventilation and temperature regularly when working in confined areas.

n. Consult with electricians before painting in areas where high voltage lines and equipment are located.

o. Keep all work areas clear of obstructions.

p. Clean up before, during, and after painting operations. Dispose of sweepings and waste daily.

Section 4. HEALTH HAZARDS

3.4.1 CAUSES. A variety of ingredients used in the manufacture of paint materials are injurious to the human body in varying degrees. while the body

Fire Hazards!



FIGURE 3-29
Keep Combustible Materials in Metal
Waste Cans Tightly Covered

can withstand nominal quantities of most of these poisons for relatively short periods of time, continuous or over exposure to them may have harmful effects. Furthermore, exposure to some may cause the body to become sensitized so that subsequent contact, even in small amounts, may cause an aggravated reaction. To this extent, these materials are a very definite threat to the normally healthy individual and a serious danger to persons with chronic illnesses or disorders. These materials are divided into two major groups, i.e., toxic materials and skin irritating materials.

3.4.1.1 Toxicity. Toxic materials may be present in the form of vapor, dust, or spray mist and may enter the body by inhalation, ingestion or by absorption through the skin. Symptoms of excessive exposure can be irritation of the nasal membranes, headache, dizziness, loss of appetite, nausea, and fatigue. Typical examples of toxic materials are as follows:

a. **Pigments:** The most common toxic pigments are lead-containing compounds and zinc chromate. Lead may be present in white or tinted paints as white lead; in primers as lead chromate, red lead, or basic lead silico chromate, and in paint driers. Refer to the specification for the analysis, and take proper precautions if the level of toxic pigment is greater than 0.5 percent of the total weight of solids in the dry paint film.

TABLE 3-2
Use the Proper Fire Extinguisher

Three Class of Fires			
Choose from these 5 basic types of extinguishers	Class A Fires Paper, wood, cloth excelsior, rubbish, etc., where quenching and cooling effect of water is required.	Class B Fires Burning liquid (gasoline oil, paints, cooking fats, etc.) where smothering action required.	Class C Fires Fires in live electrical equipment (motors, switches, appliances etc.) where a non-conducting extinguishing agent is required.
Carbon Dioxide	Small surface fires only.	YES, Excellent Carbon dioxide leaves no residue, does not affect equipment or food-stuffs.	YES, Excellent Carbon dioxide is a nonconductor, leaves no residue, will not damage equipment
Dry Chemical	Small surface fires only.	YES, Excellent Chemical absorbs heat and releases smothering gas on fire; chemical shields operator from heat.	YES, Excellent Chemical is a non-conductor; fog of dry chemical shields operator from heat.
Water	YES, Excellent Water saturates material and prevents rekindling.	NO, Water will spread fire, not put it out.	NO, Water, a conductor, should not be used on live electrical equipment.
Foam	YES, Excellent Foam has both smothering and wetting action.	YES, Excellent Smothering blanket does not dissipate, floats on top of most spilled liquids.	NO, Foam is a conductor and should never be used on live electrical equipment.
Vaporizing Liquid	Small surface fires only.	YES, Release heavy smothering gas on fire.	YES, Liquid is a nonconductor and will not damage equipment.

b. Solvents: Physical properties for many of the common paint solvents are listed in Appendix C. Most of the solvents are toxic in varying degrees and their use should be evaluated by medical/safety personnel. Threshold limit values (TLV) for these agents can be found in AFP 161-26/TB MED 265.

c. Binders: Some binders or vehicles are toxic: for example, epoxies, amines, polyurethanes, and polyesters. Avoid breathing fumes and spray or contact with skin. Wash hands and face thoroughly before eating or smoking.

3.4.1.2 Dermatitis. Dermatitic materials affect the skin. The skin becomes irritated and, if left untreated, infection can set in and incapacitation and hospitalization may result. Typical examples of dermatitic materials are:

a. Solvents: All solvents tend to remove natural oils and fats from the skin, leaving it dry, chapped, irritated, and sensitive to infection. The milder solvents, such as mineral spirits, are not as irritating to the skin as the stronger solvents such as turpentine, xylol (xylene), MEK (methyl ethyl ketone) or methylene chloride. (Methylene chloride is the most common solvent used in nonflammable paint removers.)

b. Binders and Resin Hardeners: Epoxy resins, amine hardeners, and some urethane and polyester resins irritate the skin and should be handled with special care.

3.4.1.3 Other Hazardous Materials. The following materials are also dangerous if handled carelessly:

a. Corrosive agents in paint removers and paint brush cleaners, e.g., phenol (carbolic acid).

b. Acid and alkaline cleaners; acid component of wash primer.

3.4.2 PRECAUTIONS AND PREVENTION. Health hazards can easily be avoided by a common sense approach of avoiding unnecessary contact with hazardous materials and by strict adherence to established safety measures. See Air Force Regulations AFR 161-10, Precautionary Measures for Handling Solvents and AFR 161-18, Use of Potentially Toxic and Hazardous Materials.

3.4.2.1 Specific Safety Measures. The following rules should always be strictly observed:

a. Toxic or dermatitic materials must be properly identified and kept tightly sealed when not in use.

b. A competent person designated by each service shall check the operation of paint spray booths. Equipment shall be checked at regular intervals to insure that it is safe and in proper working condition. See Industrial Ventilation; a Guide of Recommended Practices, published by the American Conference of Government Industrial Hygienists (ACGIH) for design criteria for mechanical ventilation of paint shops. Paint shops shall be provided with mechanical ventilation for year-round operation. The amount of exhaust air must exceed the amount of supply air so that a slight negative pressure is produced within the space. The air velocity passing across the face area of paint spray booths must not be less than 100 linear feet per minute.

c. Be sure that ventilation is adequate in all painting areas. Provide artificial ventilation where natural ventilation is inadequate. Use supplied air respirators, if necessary.

d. Spray all portable items within exhaust ventilated booths especially designed for that purpose.

e. Wear goggles and the proper type of respirator when spraying, blast cleaning, or performing any operation where any abnormal amount of vapor, mist, or dust is formed.

f. When handling dermatitic materials, use protective creams or preferably gloves, and wear appropriate clothing. Clean clothing should be provided daily.

g. Avoid touching any part of the body, especially the face, when handling dermatitic materials. Wash hands and face thoroughly before eating and at the end of the day.

3.4.2.2 First Aid. First aid kits, when required, must be well stocked with fresh materials and be available and easily accessible during any painting operation. All personnel should be able to give emergency first aid. However, all personnel who become ill or injured from job-related activities shall be taken immediately to the dispensary or doctor, regardless of whether or not it appears to be serious. Some toxic materials do not take full effect for days.

Section 5. HEALTH SERVICES

3.5.1 MEDICAL DEPARTMENT. The foreman must consult with the installation medical department regarding any questions or problems relating to the personal health and hygiene of the men assigned to him. Decisions in this area are to be made by the installation medical officer and must be strictly followed. Recommendations made by the medical department are to be presented to the painting crew and enforced by the foreman.

3.5.2 MEDICAL EXAMINATIONS AND RECORDS. All painting personnel are initially required to have thorough medical examinations with the results entered into their permanent record files. Subsequent examinations may be required periodically before personnel assigned to the painting crew can be exposed to any job or paint material considered to be at all hazardous. The foreman will also immediately request a medical examination of any person suspected of having an illness or affliction which may have been the result of painting operations, or which may be aggravated by intended painting operations.